United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
United States Department
of the Interior,
National Park Service

Soil Survey of Fort Bowie National Historic Site, Arizona

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, including the National Park Service; State agencies, including the Agricultural Experiment Stations; and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1996. Soil names and descriptions were approved in September 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1996. This survey was made cooperatively by the Natural Resources Conservation Service and the National Park Service.

Contents

Issued 1999

Soil Survey of
Fort Bowie National Historic Site, Arizona

By David W. Denny and Charles R. Peacock, Natural Resources Conservation Service

Fieldwork by David W. Denny and Charles R. Peacock

Range site assignment by Daniel G. Robinett, Range Conservationist, Natural Resources Conservation Service

Correlation by Philip D. Camp, State Soil Scientist, Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the United States Department of the Interior, National Park Service

General Nature of the Survey Area

The Fort Bowie National Historic Site consists of 1,000 acres. It is about 13 miles south of Bowie, in Cochise County, in southeastern Arizona. The Historic Site is east of Apache Pass, between the Dos Cabezas Mountains and the Chiricahua Mountains. It has an irregular boundary that runs generally east from Apache Pass. The area is typical of MLRA 41, Southeastern Arizona Basin and Range, and MLRU 41-1AZ, Mexican Oak-Pine Woodland and Oak Savannah (Austin, 1965). Various desert grasses and shrubs are at the lower elevations, and oak, pinyon, and juniper grow at the higher elevations on northerly aspects.

Physiography

The Fort Bowie National Historic Site is located at the southern end of the Dos Cabezas Mountains. Apache Pass separates the San Simon Valley to the northeast from the Sulphur Springs Valley to the southwest. The Dos Cabezas Mountains to the northwest are separated from the Chiricahua Mountains to the southeast by this pass. Siphon Canyon has the largest watershed inside the Historic Site. It heads near Bowie Mountain, to the south outside the park, and drains to the north. This watershed drains the eastern two-thirds of the survey area. The rest is drained by two smaller watersheds within the site, Willow Gulch and Cutoff Canyon. Elevations in the site range from 4,575 feet at the point where Siphon Canyon leaves the survey area to 5,200 feet along the southern boundary. Rolling terrain with few short, very steep side slopes typifies the southern and western two-thirds of the site. This area is dissected by numerous small drainageways. The northeastern part of the Historic Site is characterized by steep and very steep mountain side slopes dissected by few relatively large drainageways.

Geology

The Fort Bowie National Historic Site is on Apache Pass fault, an overthrust block of Pennsylvanian and Cretaceous limestone on Precambrian granite. Southwest of the fault, within the Historic Site, is a homogeneous area of coarse grained Precambrian granite. This area is dissected by many small drainageways. There are significant areas of exposed rock in the western part of the Historic Site. These are typically short, very steep to vertical granite outcroppings. Budlamp and Siphoncan soils formed in residuum and colluvium derived from granite.

In several areas, small, stable fan terraces have developed from the granitic alluvium deposited by the drainageways. Many of these alluvial deposits are less than 5 feet thick over a rock pediment. Quillian soils are typical of the soils that formed in granitic alluvium on rock pediments. Overlook soils formed in granitic alluvial deposits that are more than 5 feet thick.

The northeastern part of the Historic Site is a stratified complex of metamorphic and sedimentary rocks that range in age from the Cretaceous to the Devonian. This area is a northwest-trending overthrust block that was subsequently folded. Most of the rock type is limestone or other highly calcareous rock. This rock type includes the Cretaceous Bisbee Group, the Pennsylvanian Horquilla Limestone, and a minor inclusion of the Mississippian-Devonian Paradise Formation. At most locations, Horquilla Limestone is in contact with the Precambrian granite at Apache Pass fault. Most of the noncalcareous rocks are of the upper Bisbee Group and the Cintura Formation, which consists of grayish red siltstone and mudstone. For the purposes of this soil survey, this area can be combined into two main groups. One group consists of those rocks that are highly calcareous, such as limestone, marble, marl, and calcareous siltstone and sandstone. The other group consists of noncalcareous rocks. Yarbam soils are typical of soils that formed in residuum and colluvium derived from limestone, marble, and other calcareous rocks. Silverstrike soils formed in material derived from noncalcareous metamorphic and sedimentary rocks.

Climate

Climate data for selected stations were obtained from the USDA Centralized Forecast System (CFS), Portland, Oregon. Additional data were obtained from Fort Bowie National Historic Site records for the period from 1970 through 1977.

The Fort Bowie National Historic Site is not a record station of the CFS. The nearest CFS stations are the town of Bowie, about 13 miles north at an elevation of 3,770 feet; Chiricahua National Monument, about 10 miles south at an elevation of 5,300 feet; and the town of Wilcox, about 25 miles west at an elevation of 4,175 feet. Geographically and physiographically, Chiricahua National Monument is the station nearest to the Historic Site.

According to Historic Site records, the mean annual air temperature in the survey area is 60 degrees F. The mean temperature in January is 44 degrees F, and the mean temperature in July is 78 degrees F. The highest recorded temperature was 106 degrees in June 1974, and the lowest temperature was -15 degrees F in February 1971. Mean annual precipitation for the years 1970 through 1977 was 12.3 inches. The wettest year, 1971, had 22.8 inches of precipitation. The driest year, 1973, had 7.8 inches.

The following data are from the Chiricahua National Monument for the period 1909 through 1995.

The mean annual air temperature is 58 degrees F. The average daily maximum temperature in January is 55.6 degrees F, and the average minimum is 29.5. The hottest days occur in June, when the average daily maximum temperature is 90.5 degrees F. The warmest nights occur in July, when the average daily minimum temperature is 59.7 degrees F. The highest recorded temperature was 109 degrees F, and the lowest temperature was -10 degrees F.

The mean annual precipitation is about 19.3 inches. Of this, 9.9 inches, or about 51 percent, usually falls during the period from July to September. The driest period is typically April through June. About 8 percent of the precipitation, or 1.6 inches, falls during this time. The growing season for most plants falls between April and September. In 2 years out of 10, the rainfall from April to September is less than 5.4 inches. In 2 years out of 10, the rainfall from July to September is more than 14.5 inches. Mean annual snowfall is 11.6 inches. An average of 3 days per year have at least 1 inch of snow on the ground.

The probability for the last freezing temperature in spring, at 32 degrees F or lower, is later than May 19 for 1 year in 10 and later than May 1 for 5 years in 10. The first freezing temperature in fall is earlier than October 15 for 1 year in 10 and earlier than October 29 for 5 years in 10.

Formation of the Soils

The 1938 Yearbook of Agriculture (USDA, 1938) provided general descriptions of some of the concepts surrounding soil formation:

> Soil is the natural medium for the growth of plants. Although most soil is produced from weathered rocks, the rain and the sun have changed them greatly. Of still more importance are those changes made by the plants themselves. Thus soil is made through the influence of both physical and biological forces. It is especially the biological forces that give those characteristics to a soil or landscape that are most important to man. Essentially, all life depends upon the soil, and its important functional attribute, productivity for plants, is due more than to anything else to the operation of biological forces, particularly vegetation. There can be no life without soil and no soil without life: they have evolved together.

> All features of the natural landscape, conceived as the total environment for living organisms, are interdependent. There is a relationship between climate and vegetation, between parent rock and vegetation, between age and slope, and even between climate and slope. All express themselves in the soil, which is the final synthetic expression of the forces in the natural landscape working together, and by which the nature of the landscape can be characterized better, more completely, and more directly than by any other factor or combination of factors.

Factors of Soil Formation

Soil is the result of the combined and integrated effect of climate and living organisms acting upon the parent material, as influenced by topography and local relief over time. Soils are dynamic, natural bodies on the earth's surface that are capable of supporting plants. They are composed of mineral and organic materials, including dilute solutions, gaseous mixtures, and micro-organisms. Tremendous diversity exists in soils as a result of unique combinations of soil-forming factors. Differences in soil morphology, expressed in a vertical cross section through soil horizons, result from the combined interaction of climate, living organisms, parent material, relief, and time. Soil horizons are continually evolving in response to these factors.

Climate

Climate, past and present, has a strong effect on soil formation. Temperature and moisture affect the weathering of parent material, the release and leaching and/or accumulation of nutrients, and the activity of micro-organisms. They also influence the native plant community on the soil, which in turn influences soil formation. Wind and water transport soil material over long distances, and solar radiation affects soil moisture retention and the oxidation of organic matter on the surface. In general, weathering processes increase with both temperature and moisture.

Living Organisms

Living organisms that influence soil development include soil micro-organisms as well as plants and animals. Within the soil, the life processes of bacteria, algae, fungi, and protozoa decompose organic matter and minerals to release oxygen, carbon dioxide, and nitrogen to plants. Insects and worms burrow into the soil, redistributing soil material and creating channels for air and water movement. At the soil surface, animals trample and mix soil material, add and bury organic debris, and burrow into the ground. Surface plants provide a source of organic matter, create pores and channels with rooting networks, and reduce the effects of erosion and surface runoff. The decomposed residue of these plants also influences physical and chemical soil properties.

Distinct native plant communities occur in the survey area. These plant communities are related to the environmental factors of soil formation.

Parent Material

Parent material is the unconsolidated mineral and organic material in which soil forms. It can be derived in place from underlying bedrock (residuum) or can be transported by wind (eolian material), water (alluvium), or gravity (colluvium). The residuum derived from granite bedrock on a nearly level summit may develop into a much different soil than one formed in an alluvial stream deposit derived from limestone. The chemistry, structure, grain-size distribution, and other factors of parent material are important constituents in soil formation. The soils of the Fort Bowie National Historic Site were derived from a combination of these processes.

Relief

Relief, or topography, influences soil development through its effect on water movement and on the stability of soil material. The rate of surface runoff and of erosion by water or gravitational forces increases on steep slopes, and thus the time available for soil formation is limited. Northern aspects of steep slopes receive less solar radiation and consequently lose less moisture to evapotranspiration. In level or concave areas, runoff collects from adjoining uplands where organic matter and sediment are dropped from the alluvial waters. Soils on steep and very steep slopes are commonly unstable, and erosion occurs more rapidly than the processes of soil development. These soils are commonly shallow and have minimal development of genetic horizons. Soils in the less sloping areas tend to be more stable and develop distinct genetic horizons over time. In areas of alluvial deposition, the surface horizons are somewhat thicker and have a higher content of organic matter.

Topography in the survey area is highly variable. It ranges from broad, gently sloping areas to steep hills and ridges near faults and escarpments. The northern and western parts of the Historic Site are broken by deeply entrenched, rugged canyons with steep to nearly vertical escarpments. The narrow canyon bottoms contain nearly level and gently sloping alluvial deposits in drainageways.

Time

Time as a factor of soil formation refers to the period during which parent material has been in place and has been influenced by the other soil-forming factors. The age of a soil is related to the age or stability of the geomorphic surface on which it formed, not on the age of the landscape. Mountains are much older than the alluvial and colluvial deposits at the base of their slopes, but the surface of the more stable alluvial deposits may be much older than the more unstable mountain side slopes.

For the distinct expression of certain soil characteristics, long periods of time are needed. Other morphological features may develop in less time, but perhaps in climatic conditions known to have occurred only in the distant past.

Older soils tend to have well developed genetic horizons, but young soils generally do not show evidence of horizon development. Soils on flood plains in the canyon bottoms are subject to constant reworking and deposition of sediment during floods. Many soils on steep and very steep slopes are subject to the influence of gravity and erosion and consequently do not have the time to develop genetic horizons. Soils on many fan terraces and soils on nearly level summits of hills and mountains have very well expressed pedogenic horizons.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of native plants growing on the soils; and the kinds of bedrock. They dug holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in a pattern that is related to the geology, landform, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories, or taxons. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 1 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustolls (*Ust,* a reference to the ustic soil moisture regime, plus *olls,* from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl,* meaning minimal horizonation, plus *ustolls,* the suborder of the Mollisols that has an ustic soil moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Lithic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The texture of the surface layer or of the substratum can differ within a series. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. If there is a significant difference in one or several of these characteristics that influences use and management, then a different series is recognized. For example, soils of both the Siphoncan and Yarbam series are loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls. The Siphoncan soils formed in residuum and colluvium derived from granite, and the Yarbam soils formed in residuum and colluvium derived from limestone. Siphoncan soils have more clay in the profile, are more acid, and typically have a higher total available water capacity and a slower permeability rate than the Yarbam soils. These differences are manifested by changes in the plant community and in varying engineering interpretations.

Detailed Soil Map Units

The map units delineated on the detailed soil map in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the map, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit descriptions. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the map. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives some of the important properties and characteristics of the map unit components.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil map are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Siphoncan very gravelly coarse sandy loam is a phase of the Siphoncan series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are called complexes. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the map. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Amuzet-Riverwash complex, 0 to 5 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables give properties of the soils and the limitations, capabilities, and potentials for some specific uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

In each map unit description, a pedon, a small three-dimensional area of soil, that is typical of the associated soil series in the survey area is described. These descriptions are called taxonomic unit descriptions. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” (USDA, 1993). Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” (USDA, 1999). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description are selected soil properties and qualities and a description of the range of important characteristics of the soils in the taxonomic unit.

Map Unit Descriptions

1—Amuzet-Riverwash complex, 0 to 5 percent slopes

Setting

Landform: Flood plains and channels
Position on the landform: Bars
Frequency of flooding: Amuzet—occasional; Riverwash—frequent
Slope range: 0 to 5 percent
Elevation: 4,580 to 4,890 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Stream Segment Properties and Qualities—Siphon Canyon

Segment

Length: 8,800 feet
Width: 100 feet minimum, 200 feet maximum
Elevation: 4,890 feet upper, 4,580 feet lower

Hydrology

Flow regimen: Ephemeral
Flood zone width: 100 to 200 feet
Flooding frequency: Riverwash—frequent
Flooding duration: Very brief or brief
Months of flooding: July through October

Morphology

Active channel width: 6 to 12 feet, braided
Stability: Aggrading
Channel composition: Sand/silt/clay—15 to 35 percent; gravel—60 to 85 percent; stones and cobbles—0 to 15 percent; boulders—trace
Bank type: Cut—10 to 20 percent; uncut—80 to 90 percent; average vertical height—less than 1 foot (ranges to 3 feet)
Bank composition: Sand/silt/clay—5 to 30 percent; gravel—20 to 80 percent; stones and cobbles—0 to 30 percent; bedrock—trace; boulders—trace
Depositional bar features: Mainly side and channel bars with few point bars
Meander pattern: Irregular
Organic debris: Mainly fine floatable debris; some large anchored debris

Stream Segment Properties and Qualities—Cutoff Canyon

Segment

Length: 3,000 feet
Width: 35 feet minimum, 100 feet maximum
Elevation: 4,690 feet upper, 4,620 feet lower

Hydrology

Flow regimen: Ephemeral
Flood zone width: 35 to 48 feet
Flooding frequency: Frequent
Flooding duration: Very brief or brief
Months of flooding: July through October

Morphology

Active channel width: 6 to 12 feet, braided
Stability: Degrading
Channel composition: Sand/silt/clay—15 to 35 percent; gravel—60 to 85 percent; stones and cobbles—5 to 35 percent; boulders—trace; bedrock—trace
Bank type: Cut—30 to 50 percent; uncut—50 to 80 percent; average vertical height—2 feet (ranges to 4 feet)
Bank composition: Sand/silt/clay—5 to 30 percent; gravel—20 to 80 percent; stones and cobbles—0 to 60 percent; bedrock—trace; boulders—trace
Depositional bar features: Mainly side and channel bars with few point bars
Meander pattern: Irregular
Organic debris: Mainly fine floatable debris; some large anchored debris

Composition

Amuzet and similar soils: 50 percent
Riverwash: 40 percent
Contrasting inclusions: 10 percent
Steep soils on streambanks

Taxonomic Unit Description

Amuzet

Classification: Sandy-skeletal, mixed, thermic Aridic Ustifluvents

A—0 to 2 inches; brown (10YR 5/3) extremely gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine and few fine irregular pores; 65 percent gravel; noneffervescent; moderately alkaline (pH 8.0); clear wavy boundary.

C1—2 to 18 inches; yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4), stratified very gravelly loamy sand and gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine, medium, and coarse roots; common very fine and few fine irregular pores; 25 to 50 percent gravel; strata are 1 to 2 inches thick; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2—18 to 45 inches; brown (10YR 4/3) and light yellowish brown (10YR 6/4), stratified very gravelly sand and gravelly very fine sandy loam, very dark brown (10YR 2/2) and dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine, fine, medium, and coarse roots; common very fine, fine, and medium irregular pores; 25 to 50 percent gravel; strata are 3 to 6 inches thick; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

2Ab—45 to 60 inches; brown (7.5YR 4/3) very gravelly sandy clay loam, very dark brown (7.5YR 2.5/2) moist; massive; slightly hard, very friable, moderately sticky and slightly plastic; few very fine, fine, medium, and coarse roots; few very fine and fine irregular and tubular pores; 35 percent gravel; noneffervescent; moderately alkaline (pH 8.2).

Soil Properties and Qualities

Amuzet

Parent material: Alluvium derived from mixed sources
Content of rock fragments: Averages 35 to 60 percent but can range to 80 percent in any one horizon
Content of clay: Averages less than 5 percent but can range to 16 percent in any one horizon
Depth: More than 60 inches
Permeability rate: 6 to 20 inches/hour
Drainage class: Excessively drained
Available water capacity (total): 3.4 to 7.1 inches

A horizon:
Value—4 or 5 dry, 2 or 3 moist
Chroma—2 or 3 dry or moist
Texture—sandy loam or fine sandy loam

C horizon:
Hue—7.5YR or 10YR
Value—4 to 7 dry, 2 to 4 moist
Chroma—2 to 4 dry or moist
Texture—stratified coarse sand to very fine sandy loam

Description of the Riverwash

• Consists of gravelly and sandy alluvium derived mainly from granite with admixtures of limestone and metamorphic rock

Biotic Components

Present vegetation: Amuzet—deergrass, Arizona black walnut, southwestern rabbitbrush, catclaw acacia, Arizona ash

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Amuzet—Sandy Bottom, Subirrigated (PLWR, JUMA, FRVE2), 16-20" p.z. (041XA113AZ)

2—Historic property

This area consists of the ruins of historic Fort Bowie. The area has been drastically modified from its natural state as shown by historical records and present visual observation. Excavations, gardening, landscaping, and construction and the subsequent eroding of building foundations and walls have contributed to a complex and unnatural soil surface throughout the historic property. Bedrock outcrops of granite, sandstone, siltstone, and limestone are visible in various places within the ruins area. Because of this complexity and because of the cultural sensitivity of the area, the value of a thorough investigation of the soils would not outweigh the potential adverse impacts to the resource.

3—Overlook very gravelly coarse sandy loam, 10 to 15 percent slopes

Setting

Landform: Fan terraces
Position on the landform: Summits and shoulders
Flooding: None
Slope range: 10 to 15 percent

Elevation: 4,760 to 4,880 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Overlook and similar soils: 90 percent
Contrasting inclusions: 10 percent
Soils that have slopes of more than 15 percent
Eroded soils that do not have a mollic epipedon
Similar inclusions:
Soils that contain less than 35 percent coarse fragments

Taxonomic Unit Description

Overlook

Classification: Loamy-skeletal, mixed, superactive, thermic Pachic Argiustolls

A1—0 to 2 inches; grayish brown (10YR 5/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure parting to weak very fine granular; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular and tubular pores; 40 percent gravel; noneffervescent; slightly acid (pH 6.2); abrupt smooth boundary.

A2—2 to 6 inches; brown (10YR 4/3) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and slightly plastic; common very fine and few fine roots; few very fine irregular and tubular pores; 35 percent gravel; noneffervescent; neutral (pH 6.8); clear smooth boundary.

Bt1—6 to 18 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard and hard, very friable, moderately sticky and moderately plastic; common very fine and few fine roots; common very fine and few fine irregular pores and few very fine and fine tubular pores; common faint and few distinct clay films on faces of peds and in pores; 35 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary.

Bt2—18 to 30 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard and hard, very friable, moderately sticky and moderately plastic; common very fine roots; common very fine and few fine, medium, and coarse irregular pores, common very fine and few fine tubular pores; common faint and distinct clay films on faces of peds and in pores; 35 percent gravel; few insect tunnels and casts; noneffervescent; slightly alkaline (pH 7.4); abrupt irregular boundary.

2Bt3—30 to 60 inches; yellowish brown (10YR 5/4) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak very coarse subangular blocky structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine irregular pores; common faint clay films on faces of peds and few faint clay films in pores; 40 percent gravel, 10 percent cobbles, 3 percent stones; tonguing of material from the Bt2 horizon into the upper part of this horizon; noneffervescent; slightly alkaline (pH 7.4).

Soil Properties and Qualities

Overlook

Parent material: Alluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 18 to 35 percent
Content of organic matter: 1 to 5 percent
Drainage class: Well drained
Permeability rate: 0.6 inch to 2.0 inches/hour
Available water capacity (total): 3.7 to 6.8 inches
Lower boundary of mollic epipedon: 20 to 34 inches
Lower boundary of argillic horizon: 27 to 35 inches
Other features: Some pedons have a C horizon below the Bt horizon.

A horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—2 or 3 dry or moist

Bt horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 to 4 moist
Chroma—2 to 4 dry or moist

Biotic Components

Present vegetation: Overlook—mesquite, burroweed, broom snakeweed, shrubby buckwheat, bush muhly

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range

Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Overlook—Sandy Loam Upland, 16-20" p.z. (041XA110AZ)

4—Quillian-Budlamp-Overlook complex, 8 to 30 percent slopes

Setting

Landform: Pediments, low hills
Position on the landform: Quillian—pediments; Budlamp—shoulders and side slopes of low hills; Overlook—fan terraces
Flooding: None
Slope range: 8 to 30 percent
Elevation: 4,810 to 4,920 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Quillian and similar soils: 40 percent
Budlamp and similar soils: 35 percent
Overlook and similar soils: 10 percent
Contrasting inclusions: 15 percent
- Soils that contain more than 35 percent clay
- Soils that are 20 to 40 inches deep and contain less than 18 percent clay

Similar inclusions:
- Shallow soils that do not have a mollic epipedon

Taxonomic Unit Description

Quillian

Classification: Fine-loamy, mixed, superactive, thermic Aridic Haplustalfs

A1—0 to 1 inch; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and few fine irregular pores; 50 percent gravel; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.
A2—1 to 4 inches; brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine and medium roots; common very fine and few fine irregular pores and few very fine tubular pores; 15 percent gravel; noneffervescent; neutral (pH 7.2); abrupt wavy boundary.
A3—4 to 9 inches; brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few fine irregular and tubular pores; 25 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary.
Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine, fine, and medium roots; few very fine and medium irregular pores; common faint and few distinct clay films on faces of peds and in pores; 25 percent gravel; noneffervescent; slightly alkaline (pH 7.6); clear wavy boundary.
Bt2—16 to 26 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine, medium, and coarse roots; few very fine, fine, and medium tubular pores; few faint and distinct clay films on faces of peds and in pores; 30 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt irregular boundary.
2Cr—26 to 30 inches; weathered granite bedrock; clear smooth boundary.
2R—30 inches; hard, unweathered granite bedrock.

Budlamp

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A1—0 to 1 inch; brown (10YR 5/3) extremely gravelly coarse sandy loam, dark brown (10YR 3/3) moist; single grain and moderate very fine granular structure; loose and soft, very friable, nonsticky and nonplastic; common very fine irregular and few very fine vesicular pores; 70 percent gravel; noneffervescent; slightly acid (pH 6.0); abrupt smooth boundary.
A2—1 to 2 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; strong thick platy and moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine irregular pores; 35 percent gravel; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.
A3—2 to 6 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak very thick platy structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly

plastic; common very fine and few fine, medium, and coarse roots; few very fine and fine irregular pores; 40 percent gravel; noneffervescent; neutral (pH 6.6); clear wavy boundary.

R—6 inches; granite bedrock with a weathered rind 1 to 2 inches thick.

Overlook

Classification: Loamy-skeletal, mixed, superactive, thermic Pachic Argiustolls

A1—0 to 2 inches; grayish brown (10YR 5/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure parting to weak very fine granular; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular and tubular pores; 40 percent gravel; noneffervescent; slightly acid (pH 6.2); abrupt smooth boundary.

A2—2 to 6 inches; brown (10YR 4/3) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and slightly plastic; common very fine and few fine roots; few very fine irregular and tubular pores; 35 percent gravel; noneffervescent; neutral (pH 6.8); clear smooth boundary.

Bt1—6 to 18 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard and hard, very friable, moderately sticky and moderately plastic; common very fine and few fine roots; common very fine and few fine irregular pores and few very fine and fine tubular pores; common faint and few distinct clay films on faces of peds and in pores; 35 percent gravel; noneffervescent; slightly alkaline (pH 7.4); clear wavy boundary.

Bt2—18 to 30 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard and hard, very friable, moderately sticky and moderately plastic; common very fine roots; common very fine and few fine, medium, and coarse irregular pores, common very fine and few fine tubular pores; common faint and distinct clay films on faces of peds and in pores; 35 percent gravel; few insect tunnels and casts; noneffervescent; slightly alkaline (pH 7.4); abrupt irregular boundary.

2Bt3—30 to 60 inches; yellowish brown (10YR 5/4) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak very coarse subangular blocky structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine irregular pores; common faint clay films on faces of peds and few faint clay films in pores; 40 percent gravel, 10 percent cobbles, 3 percent stones; tonguing of material from the Bt2 horizon into the upper part of this horizon; noneffervescent; slightly alkaline (pH 7.4).

Soil Properties and Qualities

Quillian

Parent material: Alluvium derived from granite
Content of rock fragments: 15 to 35 percent gravel
Content of clay: 18 to 27 percent
Content of organic matter: Less than 1 percent
Drainage class: Well drained
Permeability rate: 0.6 inch to 2.0 inches/hour
Available water capacity (total): 2.0 to 3.7 inches
Other features: Lithochromic colors; the organic carbon content does not decrease by more than 0.6 percent with increasing depth.
Depth to unweathered bedrock: 20 to 40 inches

A horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry
Chroma—3 or 4 dry or moist

Bt horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—3 or 4 dry or moist
Texture—sandy loam or sandy clay loam

Budlamp

Parent material: Residuum and colluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 5 to 18 percent
Reaction: Moderately acid to neutral (pH 5.6 to 7.3)
Content of organic matter: 1 to 3 percent
Depth to bedrock: 5 to 20 inches
Permeability rate: 2 to 6 inches/hour
Drainage class: Well drained
Available water capacity (total): 0.5 to 1.0 inch

A horizon:
Hue—10YR or 7.5YR
Value—3 to 5 dry, 2 or 3 moist
Chroma—1 to 3 dry or moist
Texture—fine sandy loam, sandy loam, or coarse sandy loam

Overlook

Parent material: Alluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 18 to 35 percent
Content of organic matter: 1 to 5 percent
Drainage class: Well drained
Permeability rate: 0.6 inch to 2.0 inches/hour
Available water capacity (total): 3.7 to 6.8 inches
Lower boundary of mollic epipedon: 20 to 34 inches
Lower boundary of argillic horizon: 27 to 35 inches
Other features: Some pedons have a C horizon below the Bt horizon.

A horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—2 or 3 dry or moist

Bt horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 to 4 moist
Chroma—2 to 4 dry or moist

Biotic Components

Present vegetation: Hairy grama, sideoats grama, plains lovegrass, cane bluestem, turpentine bush, emory oak

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Quillian and Budlamp—Shallow Hills, 16-20" p.z. (041XA102AZ); Overlook—Sandy Loam Upland, 16-20" p.z. (041XA110AZ)

5—Silverstrike-Rock outcrop complex, 30 to 60 percent slopes

Setting

Landform: Hills and mountains
Position on the landform: Shoulders and side slopes
Flooding: None
Slope range: 30 to 60 percent
Elevation: 4,570 to 5,180 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Silverstrike and similar soils: 75 percent
Rock outcrop: 10 percent
Contrasting inclusions: 15 percent
Soils that are less than 20 inches deep
A drastically disturbed area north of the administration site is the historical quarry site for construction material during the building of Fort Bowie.

Taxonomic Unit Description

Silverstrike

Classification: Clayey-skeletal, mixed, superactive, thermic Aridic Haplustalfs

A1—0 to 2 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 3/3) moist; moderate thick platy structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine and few fine and medium irregular pores and few medium tubular pores; 25 percent gravel, 20 percent cobbles, 5 percent stones; noneffervescent; slightly acid (pH 6.4); abrupt wavy boundary.

A2—2 to 6 inches; brown (10YR 5/3) very cobbly sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky and moderate medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine and few fine irregular pores and few medium tubular pores; 30 percent gravel, 20 percent cobbles, 5 percent stones; noneffervescent; slightly acid (pH 6.2); clear wavy boundary.

Bt1—6 to 11 inches; brown (10YR 5/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine and few fine roots; few very fine irregular pores, common very fine and few fine tubular pores; common faint and few distinct clay films on faces of peds and common distinct clay films in pores; 20 percent gravel, 50 percent cobbles, 5 percent stones; noneffervescent; neutral (pH 6.6); clear wavy boundary.

Bt2—11 to 22 inches; brown (7.5YR 4/4) and yellowish red (5YR 4/6) very cobbly clay loam, dark brown (7.5YR 3/4) and dark reddish brown (5YR 3/4) moist; moderate and strong fine and medium subangular blocky structure; hard, friable, very sticky and very plastic; common very fine roots; common very fine tubular pores; many distinct clay films on faces of peds and in pores; 30 percent gravel, 20 percent cobbles;

noneffervescent; neutral (pH 6.6); abrupt smooth boundary.

2C—22 to 25 inches; dark yellowish brown (10YR 4/4) extremely gravelly clay loam, brown (7.5YR 4/4) moist; strong medium platy structure; hard, friable, very sticky and very plastic; few very fine roots; few very fine irregular and tubular pores; continuous faint clay films on coarse fragments and very few prominent clay films on coarse fragments; 75 percent gravel; noneffervescent; neutral (pH 7.0); abrupt irregular boundary.

2Cr—25 inches; weathered siltstone.

Soil Properties and Qualities

Silverstrike

Parent material: Residuum and colluvium derived from sandstone and siltstone
Content of rock fragments: 20 to 45 percent gravel, 20 to 45 percent cobbles, 0 to 5 percent stones
Content of clay: 35 to 50 percent
Content of organic matter: Less than 1 percent
Drainage class: Well drained
Permeability rate: 0.2 to 0.6 inch/hour
Available water capacity (total): 1.0 to 2.7 inches
Other features: Lithochromic colors; the organic carbon content does not decrease by more than 0.6 percent with increasing depth.
Depth to weathered bedrock: 20 to 40 inches

A horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—2 or 3 dry or moist

Bt horizon:
Hue—5YR, 7.5YR, or 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 to 6 dry or moist

C horizon:
Hue—7.5YR or 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 to 4 dry or moist

Description of the Rock Outcrop

- Consists mainly of steep outcrops of siltstone and sandstone

Biotic Components

Present vegetation: Silverstrike—curly mesquite, black grama, sideoats grama, false mesquite, shrubby buckwheat

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Silverstrike—Volcanic Hills, 16-20" p.z. (041XA111AZ)

6—Siphoncan-Budlamp complex, 10 to 40 percent slopes

Setting

Landform: Low hills
Position on the landform: Siphoncan—side slopes, summits, and shoulders; Budlamp—side slopes and shoulders
Flooding: None
Slope range: 10 to 40 percent
Elevation: 4,660 to 5,220 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Siphoncan and similar soils: 70 percent
Budlamp and similar soils: 20 percent
Contrasting inclusions: 10 percent
Soils that have accumulations of secondary calcium carbonate
Rock outcrop
Similar inclusions:
Soils that have an argillic horizon containing 20 to 27 percent clay

Taxonomic Unit Description

Siphoncan

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A1—0 to 1 inch; brown (10YR 5/3) very gravelly coarse sandy loam, brown (10YR 4/3) moist; moderate fine subangular blocky and weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine irregular pores; 50 percent gravel; noneffervescent; neutral (pH 6.6); abrupt wavy boundary.

A2—1 to 7 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few medium roots; common very fine and fine irregular and tubular pores; few faint clay films bridging mineral grains;

40 percent gravel, 10 percent cobbles, 5 percent stones; noneffervescent; slightly acid (pH 6.2); clear wavy boundary.

Bw—7 to 12 inches; yellowish brown (10YR 5/4) and brown (10YR 4/3) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) and very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine irregular and few very fine tubular pores; few faint clay films bridging mineral grains; 50 percent gravel; noneffervescent; neutral (pH 6.8); clear irregular boundary.

C—12 to 18 inches; light yellowish brown (10YR 6/4) very gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, moderately sticky and slightly plastic; few very fine and fine roots; common very fine and fine irregular pores and few very fine and fine tubular pores; very few faint clay films bridging mineral grains; 55 percent gravel; noneffervescent; neutral (pH 6.6); clear irregular boundary.

R—18 inches; hard granite bedrock.

Budlamp

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A1—0 to 1 inch; brown (10YR 5/3) extremely gravelly coarse sandy loam, dark brown (10YR 3/3) moist; single grain and moderate very fine granular structure; loose and soft, very friable, nonsticky and nonplastic; common very fine irregular and few very fine vesicular pores; 70 percent gravel; noneffervescent; slightly acid (pH 6.0); abrupt smooth boundary.

A2—1 to 2 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; strong thick platy and moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine irregular pores; 35 percent gravel; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.

A3—2 to 6 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak very thick platy structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine, medium, and coarse roots; few very fine and fine irregular pores; 40 percent gravel; noneffervescent; neutral (pH 6.6); clear wavy boundary.

R—6 inches; granite bedrock with a weathered rind 1 to 2 inches thick.

Soil Properties and Qualities

Siphoncan

Parent material: Residuum and colluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 18 to 27 percent
Reaction: Moderately acid to neutral (pH 5.6 to 7.3)
Content of organic matter: 1 to 3 percent
Drainage class: Well drained
Permeability rate: 0.6 inch to 2.0 inches/hour
Available water capacity (total): 1.0 to 1.7 inches
Depth to bedrock: 8 to 20 inches
Other features: Some pedons do not have a C horizon.

A horizon:
Hue—10YR or 7.5YR
Value—3 to 5 dry, 2 or 3 moist
Chroma—1 to 3 dry or moist

Bw horizon:
Hue—10YR or 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 to 4 dry or moist

C horizon:
Hue—10YR or 7.5YR
Value—5 or 6 dry, 4 or 5 dry
Chroma—3 to 5 dry or moist

Budlamp

Parent material: Residuum and colluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 5 to 18 percent
Reaction: Moderately acid to neutral (pH 5.6 to 7.3)
Content of organic matter: 1 to 3 percent
Depth to bedrock: 5 to 20 inches
Permeability rate: 2 to 6 inches/hour
Drainage class: Well drained
Available water capacity (total): 0.5 to 1.0 inch

A horizon:
Hue—10YR or 7.5YR
Value—3 to 5 dry, 2 or 3 moist
Chroma—1 to 3 dry or moist
Texture—fine sandy loam, sandy loam, or coarse sandy loam

Biotic Components

Present vegetation: Hairy grama, sideoats grama, plains lovegrass, cane bluestem, turpentine bush

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Shallow Hills, 16-20" p.z. (041XA102AZ)

7—Siphoncan-Rock outcrop complex, 15 to 30 percent slopes

Setting

Landform: Low hills
Position on the landform: Side slopes, summits, and shoulders
Flooding: None
Slope range: 15 to 30 percent
Elevation: 4,910 to 5,200 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Siphoncan and similar soils: 60 percent
Rock outcrop: 30 percent
Contrasting inclusions: 10 percent
- Moderately deep soils that have an argillic horizon containing 33 to 42 percent clay
- Soils that contain 5 to 18 percent clay

Similar inclusions:
- Soils that have an argillic horizon containing 20 to 27 percent clay

Taxonomic Unit Description

Siphoncan

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A1—0 to 1 inch; brown (10YR 5/3) very gravelly coarse sandy loam, brown (10YR 4/3) moist; moderate fine subangular blocky and weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine irregular pores; 50 percent gravel; noneffervescent; neutral (pH 6.6); abrupt wavy boundary.

A2—1 to 7 inches; brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few medium roots; common very fine and fine irregular and tubular pores; few faint clay films bridging mineral grains; 40 percent gravel, 10 percent cobbles, 5 percent stones; noneffervescent; slightly acid (pH 6.2); clear wavy boundary.

Bw—7 to 12 inches; yellowish brown (10YR 5/4) and brown (10YR 4/3) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) and very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine irregular and few very fine tubular pores; few faint clay films bridging mineral grains; 50 percent gravel; noneffervescent; neutral (pH 6.8); clear irregular boundary.

C—12 to 18 inches; light yellowish brown (10YR 6/4) very gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, moderately sticky and slightly plastic; few very fine and fine roots; common very fine and fine irregular and few very fine and fine tubular pores; very few faint clay films bridging mineral grains; 55 percent gravel; noneffervescent; neutral (pH 6.6); clear irregular boundary.

R—18 inches; hard granite bedrock.

Soil Properties and Qualities

Siphoncan

Parent material: Residuum and colluvium derived from granite
Content of rock fragments: More than 35 percent
Content of clay: 18 to 27 percent
Reaction: Moderately acid to neutral (pH 5.6 to 7.3)
Content of organic matter: 1 to 3 percent
Drainage class: Well drained
Permeability rate: 0.6 inch to 2.0 inches/hour
Available water capacity (total): 1.0 to 1.7 inches
Depth to bedrock: 8 to 20 inches
Other features: Some pedons do not have a C horizon.

A horizon:
Hue—10YR or 7.5YR
Value—3 to 5 dry, 2 or 3 moist
Chroma—1 to 3 dry or moist

Bw horizon:
Hue—10YR or 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 to 4 dry or moist

C horizon:
Hue—10YR or 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 to 5 dry or moist

Description of the Rock Outcrop

• Consists mainly of steep outcrops of granite with few inclusions of nearly vertical cliffs

Biotic Components

Present vegetation: Siphoncan—hairy grama, sideoats grama, plains lovegrass, cane bluestem, turpentine bush

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Siphoncan—Shallow Hills, 16-20" p.z. (041XA102AZ)

8—Yarbam-Yarbam, cool-Rock outcrop complex, 35 to 55 percent slopes

Setting

Landform: Hills and mountains
Position on the landform: Shoulders and side slopes
Flooding: None
Slope range: 35 to 55 percent
Elevation: 4,620 to 5,200 feet
Mean annual precipitation: 16 to 20 inches
Mean annual soil temperature: 59 to 64 degrees F
Frost-free period: 180 to 210 days

Composition

Yarbam and similar soils: 40 percent
Yarbam, cool, and similar soils: 25 percent
Rock outcrop: 20 percent
Contrasting inclusions: 15 percent
- Soils that are 20 to 60 inches deep and that formed in alluvium
- Soils that are 20 to 40 inches deep to a petrocalcic horizon
- Soils that formed in residuum derived from igneous rock

Similar inclusions:
- Soils that have a calcic horizon
- Soils that have high color values in the surface horizon

Taxonomic Unit Description

Yarbam

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A—0 to 7 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky and weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine irregular and few very fine tubular pores; 35 percent gravel, 5 percent cobbles; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.
C—7 to 12 inches; light gray (10YR 7/2) extremely gravelly loamy sand, very pale brown (10YR 7/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine, fine, and medium roots; few very fine, fine, and medium irregular and tubular pores; 60 percent gravel, 5 percent cobbles; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.
R—12 inches; hard limestone bedrock.

Yarbam, cool

Classification: Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

A—0 to 7 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky and weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine irregular and few very fine tubular pores; 35 percent gravel, 5 percent cobbles; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.
C—7 to 12 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine, fine, and medium irregular and tubular pores; 40 percent gravel, 5 percent cobbles; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.
R—12 inches; hard limestone bedrock.

Soil Properties and Qualities

Yarbam

Parent material: Residuum and colluvium derived from limestone
Content of rock fragments: 35 to 70 percent gravel, cobbles, and/or stones
Content of clay: 5 to 18 percent
Content of organic matter: 1 to 3 percent

Calcium carbonate equivalent: 20 to 40 percent
Reaction: Slightly alkaline or moderately alkaline (pH 7.4 to 8.4)
Depth to unweathered bedrock: 6 to 20 inches
Permeability rate: 2 to 6 inches/hour
Drainage class: Well drained
Available water capacity (total): 0.3 to 0.7 inch

A horizon:
Hue—7.5YR or 10YR
Value—2 to 5 dry, 2 to 4 moist
Chroma—1 to 3 dry or moist
Texture—loam, fine sandy loam, or sandy loam

C horizon:
Hue—7.5YR or 10YR
Value—2 to 7 dry or moist
Chroma—1 to 3 dry or moist
Texture—loam, fine sandy loam, sandy loam, or loamy sand

Yarbam, cool

Parent material: Residuum and colluvium derived from limestone
Content of rock fragments: 35 to 70 percent gravel, cobbles, and/or stones
Content of clay: 5 to 18 percent
Content of organic matter: 1 to 3 percent
Calcium carbonate equivalent: 20 to 40 percent
Reaction: Slightly alkaline or moderately alkaline (pH 7.4 to 8.4)
Depth to unweathered bedrock: 6 to 20 inches
Permeability rate: 2 to 6 inches/hour
Drainage class: Well drained
Available water capacity (total): 0.3 to 0.7 inch

A and C horizons:
Hue—7.5YR or 10YR
Value—2 to 5 dry, 2 to 4 moist
Chroma—1 to 3 dry or moist
Texture—loam, fine sandy loam, or sandy loam

Description of the Rock Outcrop

- Consists mainly of steep outcrops of limestone and calcareous sandstone

Biotic Components

Present vegetation: Yarbam—black grama, slim tridens, blue threeawn, southwestern stipa, false mesquite, ocotillo; Yarbam, cool—black grama, slim tridens, blue threeawn, southwestern stipa, false mesquite, mountainmahogany, pinyon pine, oneseed juniper

Interpretive Groups

Land capability classification: VIs, nonirrigated
Major Land Resource Area: 41—Southeastern Arizona Basin and Range
Major Land Resource Unit: 41-1AZ—Mexican Oak-Pine Woodland and Oak Savannah
Ecological site: Yarbam and Yarbam, cool—Limestone Hills, 16-20" p.z. (041XA103AZ)

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil map. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Classification and Index Properties

Table 3 gives estimates of the engineering classification for the major layers of each soil in the survey area, and table 4 gives estimates of the range of index properties. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

In the tables, *depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under the heading “Detailed Soil Map Units.”

In table 3, *texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Gravelly (G) and sandy (S) soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC. These soils have more than half of the material of individual grains visible to the naked eye. The W denotes an even distribution or wide range in grain sizes. If one grain size predominates, then P is used. For gravelly or sandy soils with a significant inclusion of fines, M is used for nonplastic or low plastic fines and C for plastic fines. If more than half of the individual grains are invisible to the naked eye, the soil is considered to be a silty (M) or clayey (C) soil. These soils are classified as ML, CL, MH, or CH. If the soil has a pronounced organic odor, then OL or OH is used. The letter L is used for soils that have a low liquid limit, and H is used for those with a high liquid limit. Soils classified as PT are highly organic (peat). Soils exhibiting engineering properties of two groups can have a dual classification, for example, SC-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

In table 4, *rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 5 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In the table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^{1}/_{3}$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In the table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect retention of water and depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, 6 to 9 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. The soils assigned to group 1 are the most susceptible to soil blowing, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 5, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning plant residue to the soil and protecting the soil from erosion. Organic matter affects the available water capacity, infiltration rate, and erosion potential. It is a source of nitrogen and other nutrients for plants.

Soil and Water Features

Table 6 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

The table gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for pasture, as rangeland and woodland, as sites for parks and other recreational facilities, and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Land Capability Classification

The system of land capability classification used by the Natural Resources Conservation Service shows, in a general way, the suitability of soils for most kinds of agricultural field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, VIs. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Generally, soils in capability classes I, II, III, and IV have a dependable supply of moisture from precipitation or irrigation that is adequate for the establishment of agricultural field crops. Because of limited precipitation in the survey area, irrigation is needed on most soils to supply sufficient moisture for plant growth. The limited precipitation, however, does not preclude the establishment of adapted species for rangeland reseeding or reclamation efforts on nonirrigated soils. Typically, a soil classified as Vw has a water table close enough to the surface for the establishment and growth of adapted plant species. A soil classified as VIc might have soil properties that would place it in class I or class II if it were irrigated. Therefore, a soil classified as VIc could be ideal for reseeding efforts if the timing of seasonal precipitation is taken into account during the planning process.

In this survey area, capability classes V, VI, and VII are used for nonirrigated soils. The capability classification of each soil is given in the section “Detailed Soil Map Units.”

Also given in the map unit descriptions are the major land resource area, the major land resource unit, and the ecological site for each map unit. Information regarding these interpretive groups is available at the local office of the Natural Resources Conservation Service.

Rangeland

In this soil survey, rangeland is considered a type of land rather than a kind of land use. If well managed, some woodland can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees. Understory vegetation consists of grasses, forbs, shrubs, and other plants.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil that supports rangeland vegetation suitable for grazing, the ecological site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. An explanation of the column headings in table 7 follows.

An *ecological site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other ecological sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, ecological sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table also are important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland or woodland understory that supports the potential natural plant community. Except for the overstory trees on woodland sites, it includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year’s growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperature make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Woodland Management and Productivity

Woodland is important in the survey area because of its influence on recreation, wildlife habitat, and fire management. Table 8 shows only the soils that can sustain a woodland plant community. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The numbers 0 and 1 indicate low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter A indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are species that are adapted to the area and are typically present in the plant community.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils that are subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Engineering

The information in tables 3, 4, 5, and 6, along with the soil map, the soil descriptions, and other data provided in this survey, can be used by qualified personnel to make interpretations relating to building site development, sanitary facilities, and water management. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil. The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government and local ordinances and regulations should be considered in planning, site selection, and project design.

During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential and recreational site development; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

Building Site Development

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for building sites, utility lines, open ditches, and other purposes. The ease of digging, filling, and compacting is affected by the depth to bedrock, a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding.

Sanitary Facilities

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Usually, only that part of the soil between depths of 24 and 72 inches is evaluated. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Considered are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Usually, only that part of the soil within a depth of about 6 feet is considered. Deeper trenches may have limitations beyond the depth of observation. Onsite investigation is needed.

Soil material is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread. Sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Water Management

Soil properties and site features affect design and maintenance of pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds.

Pond reservoir areas hold water behind a dam or embankment. Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Soils are a source of material for embankment fill. It is assumed that soil layers will be uniformly mixed and compacted during construction. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

The properties that affect the ability of the natural soil to support an embankment may extend beyond the depth of observation. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, salts, or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the number of large stones affect the ease of excavation.

Other water management considerations involve drainage, irrigation, terraces and diversions, and grassed waterways.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

References

American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.

Austin, Morris E. 1965. Land resource regions and major land resource areas of the United States. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture. 1938. Soils and men. U.S. Department of Agriculture Yearbook.

United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

United States Department of Agriculture. 1993. Soil survey manual. Soil Conservation Service, Soil Survey Staff, U.S. Department of Agriculture Handbook 18.

United States Department of Agriculture. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, Soil Survey Staff, U.S. Department of Agriculture Handbook 436.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this survey, the capacity is expressed in inches for a 60-inch profile or to a limiting layer.

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated). Erosion much more rapid

than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential plant community. See Climax vegetation.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The position that forms the uppermost inclined surface near the top of a hillslope. It is a transition from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, the following slope classes are recognized:

Nearly level	0 to 3 percent
Gently sloping or undulating	3 to 7 percent
Strongly sloping or rolling	7 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 55 percent
Very steep	55 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth’s surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Classification of the Soils

Soil name	Classification
Amuzet	Sandy-skeletal, mixed, thermic Aridic Ustifluvents
Budlamp	Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls
Overlook	Loamy-skeletal, mixed, superactive, thermic Pachic Argiustolls
Quillian	Fine-loamy, mixed, superactive, thermic Aridic Haplustalfs
Silverstrike	Clayey-skeletal, mixed, superactive, thermic Aridic Haplustalfs
Siphoncan	Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls
Yarbam	Loamy-skeletal, mixed, superactive, thermic Lithic Haplustolls

Table 2.--Acreage and Proportionate Extent of the Soils

Map symbol	Map unit name	Acres	Percent
1	Amuzet-Riverwash complex, 0 to 5 percent slopes	40	4.0
2	Historic property	37	3.7
3	Overlook very gravelly coarse sandy loam, 10 to 15 percent slopes	47	4.7
4	Quillian-Budlamp-Overlook complex, 8 to 30 percent slopes	60	6.0
5	Silverstrike-Rock outcrop complex, 30 to 60 percent slopes	101	10.1
6	Siphoncan-Budlamp complex, 10 to 40 percent slopes	458	45.8
7	Siphoncan-Rock outcrop complex, 15 to 30 percent slopes	99	9.9
8	Yarbam-Yarbam, cool-Rock outcrop complex, 35 to 55 percent slopes	158	15.8
	Total	1,000	100.0

Table 3.--Engineering Classification

Map symbol	Soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO
		In			
1	Amuzet	0-2	GRX-SL	GP-GM	A-1
		2-45	SR GRV-S GR-VFSL	GM, GP, SP	A-1
		45-60	GRV-SCL	GC, SC	A-2, A-6
	Riverwash	0-6	COS	SP, SP-SM, SW, SW-SM	A-1
		6-60	SR COS S	GW, SW, SP, GP	A-1
2	Historic property.				
3	Overlook	0-2	GRV-COSL	GM-GC, GM	A-1
		2-6	GRV-SCL	GC	A-2
		6-30	GRV-SCL	GC	A-2
		30-60	GRV-SCL	GC, GP-GC	A-2
4	Quillian	0-1	GRV-SL	GM-GC, GP-GM, SP-SC	A-1
		1-9	GR-SL	GM-GC, GM, SC-SM, SM	A-1, A-2
		9-26	GR-SCL	GC, GM-GC, SC, SC-SM	A-2, A-6
		26-30	WB	---	---
		30	UWB	---	---
	Budlamp	0-1	GRX-COSL	GP, GP-GM	A-1
		1-6	GRV-SL	GM-GC, GP-GM, SP-SM	A-1
		6	UWB	---	---
	Overlook	0-2	GRV-COSL	GM-GC, GM	A-1
		2-6	GRV-SCL	GC	A-2
		6-30	GRV-SCL	GC	A-2
		30-60	GRV-SCL	GC, GP-GC	A-2
5	Silverstrike	0-2	CBV-SL	GM-GC, GM, SC-SM, SM	A-1
		2-6	CBV-SCL	GC, GM-GC	A-1, A-2
		6-22	CBX-CL CBV-CL	GC	A-2, A-6, A-7
		22-25	GRX-CL	GC, GP-GC	A-2
		25	WB	---	---
	Rock outcrop	0-60	UWB	---	---
6	Siphoncan	0-1	GRV-COSL	GP-GC, GP-GM	A-1
		1-7	GRV-SL	GM-GC, GM, GP-GC	A-1
		7-18	GRV-SCL	GC, GM-GC, GP-GC	A-1, A-2
		18	UWB	---	---
	Budlamp	0-1	GRX-COSL	GP, GP-GM	A-1
		1-6	GRV-SL	GM-GC, GP-GM, SP-SM	A-1
		6	UWB	---	---
7	Siphoncan	0-1	GRV-COSL	GP-GC, GP-GM	A-1
		1-7	GRV-SL	GM-GC, GM, GP-GC	A-1
		7-18	GRV-SCL	GC, GM-GC, GP-GC	A-1, A-2
		18	UWB	---	---
	Rock outcrop	0-60	UWB	---	---
8	Yarbam	0-7	GRV-SL	GM-GC, GP-GM, SP-SM	A-1
		7-12	GRX-LS	GP, GP-GC, GP-GM	A-1
		12	UWB	---	---
	Yarbam, cool	0-7	GRV-SL	GM-GC, GM, GP-GC	A-1, A-4
		7-12	GRV-L	GM-GC, GM	A-1, A-4
		12	UWB	---	---
	Rock outcrop	0-60	UWB	---	---

Table 4.--Engineering Index Properties

Map symbol	Soil name	Depth	Fragments >3 inches	Percent passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
		In	Pct					Pct	
1	Amuzet-------------	0-2	0-10	20-35	10-25	5-20	5-10	20-25	0-5
		2-45	0-10	40-60	30-50	15-40	0-20	10-15	0-5
		45-60	0-5	55-75	50-70	40-65	20-40	35-45	15-20
	Riverwash----------	0-6	0-10	80-90	75-90	20-35	0-5	15-20	0-5
		6-60	0-15	20-90	20-80	10-20	0-5	15-20	0-5
2	Historic property.								
3	Overlook-----------	0-2	0-0	50-60	40-50	20-30	5-15	15-25	0-5
		2-6	0-0	50-60	40-50	30-45	15-30	25-35	10-15
		6-30	0-0	50-60	40-50	30-45	20-35	35-45	15-25
		30-60	10-25	40-60	30-50	25-45	10-30	25-35	10-15
4	Quillian-----------	0-1	0-5	30-55	25-50	15-35	5-20	20-25	5-10
		1-9	0-5	55-80	50-75	30-50	15-30	20-25	5-10
		9-26	0-5	55-80	50-75	40-70	20-40	25-30	10-15
		26-30	---	---	---	---	---	---	---
		30	---	---	---	---	---	---	---
	Budlamp------------	0-1	0-5	30-40	15-25	5-20	0-5	15-25	0-5
		1-6	0-5	45-60	35-50	15-35	5-20	15-25	0-5
		6	---	---	---	---	---	---	---
	Overlook-----------	0-2	0-0	50-60	40-50	20-30	5-15	15-25	0-5
		2-6	0-0	50-60	40-50	30-45	15-30	25-35	10-15
		6-30	0-0	50-60	40-50	30-45	20-35	35-45	15-25
		30-60	10-25	40-60	30-50	25-45	10-30	25-35	10-15
5	Silverstrike-------	0-2	25-40	50-70	45-65	25-45	15-25	15-25	0-5
		2-6	25-40	40-65	35-60	25-55	10-35	25-30	5-10
		6-22	40-55	30-60	25-55	20-55	15-45	35-50	15-30
		22-25	0-0	15-25	10-20	5-20	5-15	35-50	15-30
		25	---	---	---	---	---	---	---
	Rock outcrop-------	0-60	---	---	---	---	---	---	---
6	Siphoncan----------	0-1	0-0	40-50	30-40	15-25	5-10	15-25	0-5
		1-7	10-25	40-60	30-50	15-35	10-20	15-25	0-5
		7-18	0-0	45-50	35-40	25-35	15-25	25-35	10-15
		18-28	---	---	---	---	---	---	---
	Budlamp------------	0-1	0-5	30-40	15-25	5-20	0-5	15-25	0-5
		1-6	0-5	45-60	35-50	15-35	5-20	15-25	0-5
		6	---	---	---	---	---	---	---
7	Siphoncan----------	0-1	0-0	40-50	30-40	15-25	5-10	15-25	0-5
		1-7	10-25	40-60	30-50	15-35	10-20	15-25	0-5
		7-18	0-0	45-50	35-40	25-35	15-25	25-35	10-15
		18	---	---	---	---	---	---	---
	Rock outcrop-------	0-60	---	---	---	---	---	---	---
8	Yarbam-------------	0-7	0-20	25-55	20-50	10-35	5-20	15-25	0-10
		7-12	0-10	20-30	15-25	5-20	0-10	15-20	0-0
		12	---	---	---	---	---	---	---
	Yarbam, cool-------	0-7	0-20	25-55	20-50	15-50	10-40	15-25	0-5
		7-12	0-10	45-55	40-50	35-50	25-40	15-25	0-5
		12	---	---	---	---	---	---	---
	Rock outcrop-------	0-60	---	---	---	---	---	---	---

Table 5.--Physical and Chemical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
1:												
Amuzet---------	0-2	12-15	1.35-1.55	2.0-6.0	0.01-0.05	7.4-8.4	---	Low------	0.02	5	8	0.0-0.5
	2-45	3-8	1.55-1.65	6.0-20	0.05-0.11	7.4-8.4	---	Low------	0.10			0.0-0.5
	45-60	25-35	1.55-1.75	0.2-0.6	0.08-0.15	7.4-8.4	---	Moderate	0.05			0.5-1.0
Riverwash------	0-6	0-1	1.60-1.80	20-20	0.03-0.04	6.1-8.4	0-2	Low------	0.02	5	2	0.0-0.1
	6-60	0-5	1.60-1.80	20-20	0.01-0.03	6.1-8.4	0-2	Low------	0.02			0.0-0.1
2. Historic property												
3--------------- Overlook	0-2	8-15	1.35-1.75	2.0-6.0	0.04-0.08	6.1-7.8	---	Low------	0.05	5	6	3.0-5.0
	2-6	20-27	1.55-1.75	0.6-2.0	0.08-0.12	6.1-7.8	---	Low------	0.05			3.0-5.0
	6-30	28-35	1.55-1.75	0.6-2.0	0.08-0.12	6.1-7.8	---	Moderate	0.05			1.0-3.0
	30-60	20-27	1.55-1.75	0.6-2.0	0.05-0.11	6.1-7.8	---	Low------	0.05			0.0-1.0
4:												
Quillian-------	0-1	10-15	1.35-1.55	2.0-6.0	0.03-0.08	6.1-7.3	---	Low------	0.05	2	6	0.0-1.0
	1-9	12-18	1.35-1.55	2.0-6.0	0.05-0.11	6.6-7.8	---	Low------	0.10			0.0-1.0
	9-26	20-27	1.55-1.75	0.6-2.0	0.09-0.16	6.6-7.8	---	Moderate	0.10			0.0-1.0
	26-30	---	---	0.01-20	---	---	---	---------	----			---
	30	---	---	0.00-0.01	---	---	---	---------	----			---
Budlamp--------	0-1	5-18	1.55-1.65	6.0-20	0.01-0.03	5.6-6.5	---	Low------	0.02	1	8	1.0-3.0
	1-6	5-18	1.35-1.75	2.0-6.0	0.04-0.08	6.1-7.3	---	Low------	0.05			1.0-2.0
	6	---	---	0.00-0.01	---	---	---	---------	----			---
Overlook-------	0-2	8-15	1.35-1.75	2.0-6.0	0.04-0.08	6.1-7.8	---	Low------	0.05	5	6	3.0-5.0
	2-6	20-27	1.55-1.75	0.6-2.0	0.08-0.12	6.1-7.8	---	Low------	0.05			3.0-5.0
	6-30	28-35	1.55-1.75	0.6-2.0	0.08-0.12	6.1-7.8	---	Moderate	0.05			1.0-3.0
	30-60	20-27	1.55-1.75	0.6-2.0	0.05-0.11	6.1-7.8	---	Low------	0.05			0.0-1.0
5:												
Silverstrike---	0-2	8-15	1.35-1.55	2.0-6.0	0.03-0.08	6.1-7.3	---	Low------	0.05	3	6	0.0-1.0
	2-6	20-27	1.55-1.75	0.2-0.6	0.05-0.11	6.1-7.3	---	Low------	0.05			0.0-1.0
	6-22	35-50	1.25-1.55	0.2-0.6	0.03-0.10	6.1-7.3	---	Moderate	0.05			0.0-1.0
	22-25	35-50	1.25-1.55	0.2-0.6	0.03-0.06	6.1-7.3	---	Moderate	0.05			0.0-0.5
	25	---	---	0.00-0.2	---	---	---	---------	----			---
Rock outcrop---	0-60	---	---	0.06-6.0	---	---	---	---------	----	---	8	---
6:												
Siphoncan------	0-1	8-15	1.35-1.75	2.0-6.0	0.03-0.07	6.1-7.3	---	Low------	0.05	1	6	1.0-3.0
	1-7	8-18	1.35-1.55	2.0-6.0	0.03-0.08	6.1-7.3	---	Low------	0.05			1.0-3.0
	7-18	20-27	1.55-1.75	0.6-2.0	0.07-0.10	6.1-7.3	---	Low------	0.05			0.0-1.0
	18	---	---	0.00-0.01	---	---	---	---------	----			---
Budlamp--------	0-1	5-18	1.55-1.65	6.0-20	0.01-0.03	5.6-6.5	---	Low------	0.02	1	8	1.0-3.0
	1-6	5-18	1.35-1.75	2.0-6.0	0.04-0.08	6.1-7.3	---	Low------	0.05			1.0-2.0
	6	---	---	0.00-0.01	---	---	---	---------	----			---
7:												
Siphoncan------	0-1	8-15	1.35-1.75	2.0-6.0	0.03-0.07	6.1-7.3	---	Low------	0.05	1	6	1.0-3.0
	1-7	8-18	1.35-1.55	2.0-6.0	0.03-0.08	6.1-7.3	---	Low------	0.05			1.0-3.0
	7-18	20-27	1.55-1.75	0.6-2.0	0.07-0.10	6.1-7.3	---	Low------	0.05			0.0-1.0
	18	---	---	0.00-0.01	---	---	---	---------	----			---

Table 5.--Physical and Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
7:												
Rock outcrop---	0-60	---	---	0.06-6.0	---	---	---	---------	----	---	8	---
8:												
Yarbam---------	0-7	5-18	1.35-1.55	2.0-6.0	0.02-0.08	7.4-8.4	0-2	Low------	0.05	1	6	1.0-3.0
	7-12	5-10	1.45-1.65	2.0-6.0	0.01-0.03	7.4-8.4	0-2	Low------	0.02			1.0-2.0
	12	---	---	0.00-0.06	---	---	---	---------	----			---
Yarbam, cool---	0-7	5-18	1.25-1.55	0.6-2.0	0.03-0.12	7.4-8.4	0-2	Low------	0.05	1	6	1.0-3.0
	7-12	5-18	1.25-1.55	2.0-6.0	0.06-0.12	7.4-8.4	0-2	Low------	0.10			1.0-2.0
	12	---	---	---	---	---	---	---------	----			---
Rock outcrop---	0-60	---	---	0.06-6.0	---	---	---	---------	----	---	8	---

Table 6.--Soil and Water Features

Map symbol and soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					In				
1:									
Amuzet---------	B	Occasional	Brief-----	Jul-Sep	>60	---	None-----	Moderate	Low.
Riverwash------	A	Frequent---	Brief-----	Jun-Mar	>60	---	None-----	Moderate	Low.
2. Historic property									
3--------------- Overlook	B	None-------	---	---	>60	---	None-----	Moderate	Low.
4:									
Quillian-------	C	None-------	---	---	20-40	Soft----	None-----	Moderate	Low.
Budlamp--------	D	None-------	---	---	5-20	Hard----	None-----	Moderate	Moderate.
Overlook-------	B	None-------	---	---	>60	---	None-----	Moderate	Low.
5:									
Silverstrike---	C	None-------	---	---	20-40	Soft----	None-----	Moderate	Low.
Rock outcrop---	D	None-------	---	---	0-0	Hard----	None-----	---	---
6:									
Siphoncan------	D	None-------	---	---	8-20	Hard----	None-----	Moderate	Low.
Budlamp--------	D	None-------	---	---	5-20	Hard----	None-----	Moderate	Moderate.
7:									
Siphoncan------	D	None-------	---	---	8-20	Hard----	None-----	Moderate	Low.
Rock outcrop---	D	None-------	---	---	0-0	Hard----	None-----	---	---
8:									
Yarbam---------	D	None-------	---	---	6-20	Hard----	None-----	High-----	Low.
Yarbam, cool---	D	None-------	---	---	6-20	Hard----	None-----	High-----	Low.
Rock outcrop---	D	None-------	---	---	0-0	Hard----	None-----	---	---

Table 7.--Rangeland Productivity and Characteristic Plant Communities

(Only the soils that support rangeland vegetation suitable for grazing are listed. The abbreviation "p.z." means precipitation zone.)

Map symbol and soil name	Ecological site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1:					
Amuzet	Sandy Bottom, Subirrigated (PLWR, JUMA, FRVE2), 16-20" p.z.	Favorable	2,000	Deergrass	15
		Normal	1,500	Skunkbush sumac	5
		Unfavorable	1,000	Velvet mesquite	5
				Other perennial forbs	5
				Catclaw mimosa	5
				Plains lovegrass	5
				Southwest rabbitbrush	5
				Sideoats grama	5
				Cane beardgrass	5
				Desertbroom	5
				Seepwillow	5
				Other shrubs	15
				Other perennial grasses	10
				Catclaw acacia	10
Riverwash.					
2.					
Historic property					
3	Sandy Loam Upland, 16-20" p.z.	Favorable	2,600	Cane beardgrass	15
Overlook		Normal	2,000	Other shrubs	5
		Unfavorable	1,200	Other perennial grasses	5
				Other perennial forbs	5
				Shrubby buckwheat	5
				Other annual forbs	5
				Green sprangletop	10
				Plains lovegrass	10
				Arizona cottontop	10
				Blue grama	15
				Sideoats grama	15
4:					
Quillian	Shallow Hills, 16-20" p.z.	Favorable	1,200	Texas bluestem	10
		Normal	900	Crinkleawn	5
		Unfavorable	600	Other perennial grasses	5
				Other perennial forbs	5
				Pinyon ricegrass	5
				Prairie junegrass	5
				Oneseed juniper	5
				Shrubby buckwheat	5
				Cane beardgrass	5
				Beggartick grass	5
				Other shrubs	10
				Bullgrass	10
				Plains lovegrass	10
				Sideoats grama	10
				Other annual forbs	5

Table 7.--Rangeland Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
4:					
Budlamp	Shallow Hills, 16-20" p.z.	Favorable	1,500	Texas bluestem	10
		Normal	1,000	Other shrubs	5
		Unfavorable	750	Other perennial grasses	5
				Other perennial forbs	5
				Green sprangletop	5
				Prairie junegrass	5
				Coralbean	5
				California brickellbush	5
				Beggartick grass	5
				Oak species	10
				Bullgrass	10
				Plains lovegrass	10
				Sideoats grama	10
				Bush morningglory	5
				Palmer agave	5
Overlook	Sandy Loam Upland, 16-20" p.z.	Favorable	2,600	Cane beardgrass	15
		Normal	2,000	Other shrubs	5
		Unfavorable	1,200	Other perennial grasses	5
				Other perennial forbs	5
				Shrubby buckwheat	5
				Other annual forbs	5
				Green sprangletop	10
				Plains lovegrass	10
				Arizona cottontop	10
				Blue grama	15
				Sideoats grama	15
5:					
Silverstrike	Volcanic Hills, 16-20" p.z.	Favorable	1,200	Sideoats grama	20
		Normal	900	Other shrubs	5
		Unfavorable	500	Other perennial grasses	5
				Other perennial forbs	5
				Tanglehead	5
				Shrubby buckwheat	5
				False mesquite	5
				Cane beardgrass	5
				Other annual forbs	5
				Green sprangletop	10
				Texas bluestem	10
				Plains lovegrass	20
Rock outcrop.					
6:					
Siphoncan	Shallow Hills, 16-20" p.z.	Favorable	1,200	Texas bluestem	10
		Normal	900	Crinkleawn	5
		Unfavorable	600	Other perennial grasses	5
				Other perennial forbs	5
				Pinyon ricegrass	5
				Prairie junegrass	5
				Oneseed juniper	5
				Shrubby buckwheat	5
				Cane beardgrass	5
				Beggartick grass	5
				Other shrubs	10
				Bullgrass	10
				Plains lovegrass	10
				Sideoats grama	10
				Other annual forbs	5

Table 7.--Rangeland Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
6:					
Budlamp	Shallow Hills, 16-20" p.z.	Favorable	1,500	Texas bluestem	10
		Normal	1,000	Other shrubs	5
		Unfavorable	750	Other perennial grasses	5
				Other perennial forbs	5
				Green sprangletop	5
				Prairie junegrass	5
				Coralbean	5
				California brickellbush	5
				Beggartick grass	5
				Oak species	10
				Bullgrass	10
				Plains lovegrass	10
				Sideoats grama	10
				Bush morningglory	5
				Palmer agave	5
7:					
Siphoncan	Shallow Hills, 16-20" p.z.	Favorable	1,200	Texas bluestem	10
		Normal	900	Crinkleawn	5
		Unfavorable	600	Other perennial grasses	5
				Other perennial forbs	5
				Pinyon ricegrass	5
				Prairie junegrass	5
				Oneseed juniper	5
				Shrubby buckwheat	5
				Cane beardgrass	5
				Beggartick grass	5
				Other shrubs	10
				Bullgrass	10
				Plains lovegrass	10
				Sideoats grama	10
				Other annual forbs	5
Rock outcrop.					
8:					
Yarbam	Limestone Hills, 16-20" p.z.	Favorable	1,000	Cane beardgrass	15
		Normal	700	Rough tridens	5
		Unfavorable	500	Slim tridens	5
				Southwestern stipa	5
				Other perennial grasses	5
				Other perennial forbs	5
				Ocotillo	5
				Plains lovegrass	5
				False mesquite	5
				Black grama	5
				Blue threeawn	5
				Other annual forbs	5
				Other shrubs	10
				Sideoats grama	15
				Mariola	5

Table 7.--Rangeland Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total production		Characteristic vegetation	Compo-sition
		Kind of year	Dry weight		
			Lb/acre		Pct
8:					
Yarbam, cool	Limestone Hills, 16-20" p.z.	Favorable	1,500	Southwestern stipa	10
		Normal	1,100	Wooly bunchgrass	10
		Unfavorable	700	Prairie junegrass	5
				Other shrubs	5
				Texas bluestem	5
				Oneseed juniper	5
				Other perennial grasses	10
				Mountainmahogany	5
				Plains lovegrass	5
				Pinyon ricegrass	5
				Desert ceanothus	10
				Bullgrass	5
				Black grama	5
				Sideoats grama	5
				Other perennial forbs	5
				Other annual forbs	5
Rock outcrop.					

Table 8.--Woodland Management and Productivity

(Only the soils suitable for supporting a woodland plant community are listed.)

Map symbol and soil name	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*	Trees to plant
1:										
Amuzet	1/2F	Severe	Slight	Slight	Slight	Severe	Arizona white oak	---	.5	Netleaf hackberry, desertwillow, oneseed juniper, Fremont cottonwood, mesquite, Arizona white oak, Mexican blue oak, alligator juniper, western soapberry, Arizona black walnut, Arizona ash, Goddings willow.
							Netleaf hackberry	---	---	
							Desertwillow	---	.5	
							Oneseed juniper	---	---	
							Fremont cottonwood	---	---	
							Goddings willow	---	---	
							Mesquite	---	---	
							Mexican blue oak	---	---	
							Ariz. black walnut	---	1	
							Arizona ash	---	1	
Riverwash.										

*Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of the mean annual increment for fully stocked natural stands.

Table 9.--Recreational Development

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
1:				
Amuzet	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
Riverwash	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy, flooding.	Severe: too sandy.
2. Historic property				
3 Overlook	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight.
4:				
Quillian	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
Budlamp	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
Overlook	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight.
5:				
Silverstrike	Severe: slope, large stones, small stones.	Severe: slope, large stones, small stones.	Severe: large stones, slope, small stones.	Severe: slope.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
6:				
Siphoncan	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
Budlamp	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
7:				
Siphoncan	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.

Table 9.--Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
8:				
Yarbam	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
Yarbam, cool	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.